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HURRICANE GATE STRUCTURE 4
(HGS4)

HAER No. FL-5

Herbert Hoover Dike on Lake Okeechobee
Belle Glade
Palm Beach County
Florida

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING SURVEY
National Park Service
Southeast Region
Department of the Interior
Atlanta, Georgia 30303

HISTORIC AMERICAN BUILDINGS SURVEY

HURRICANE GATE STRUCTURE 4 (HGS4)

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Location: Hurricane Gate Structure 4 (HGS 4) is located in the Herbert Hoover Dike (L-D2), on the southeast shore of Lake Okeechobee, at the junction of Hillsboro and North New River Canals, near Belle Glade (see attached map #1).

Date of Construction: 1935

Present Owner: U.S. Army Corps of Engineers

Present Use: Hurricane Gate Structure 4 is a primary outlet for regulatory and irrigation releases from Lake Okeechobee. The maximum allowable discharge is approximately 150 cubic feet per second (c.f.s.).

Significance: Construction of Hurricane Gate Structure 4 was authorized by the River and Harbor Act of July 3, 1930. As such, it was part of the first major federal project in the central and southern Florida area. The project was developed, in part, in response to the effects of the 1926 and 1928 hurricanes. An estimated 2,500 people were drowned around Lake Okeechobee, and as a result, the hurricanes gained the dubious distinction of being considered great national disasters.

Included in the 1930 project were the 8-foot-deep navigational channel from the Intracoastal Waterway near Stuart, Florida (via the St. Lucie River and Canal, Lake Okeechobee, and the Caloosahatchee Canal and River) to Fort Myers. Locks and control works were built near Stuart and at Moore Haven and Ortona. The project also entailed construction of 68 miles of levees along the south shore of Lake Okeechobee and 16 miles along the lake's north shore, and hurricane gates and 10-foot-diameter gated culvert structures. These facilities were designed to aid navigation, and to protect life and property around Lake Okeechobee. Because this project was authorized and begun during President Herbert Hoover's administration, the Lake Okeechobee levees were named the "Herbert Hoover Dike" in 1961.

Hurricane Gate Structure 4 is an example of early waterworks. Its significance as a historic resource derives from the fact that it represents an early engineering solution to flood control that has continued to function for 50 years.

Project Information: This documentation was undertaken in 1986 in accordance with the Memorandum of Agreement by the U.S. Army Corps of Engineers, Jacksonville District, as a mitigative measure prior to modification.

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Jacksonville District 1986

Edited and Transmitted By:

PART I: HISTORICAL INFORMATION

A. Physical History:

1. Date of erection: 1935 (completed February 26, 1935) (Report of Chief of Engineers, U.S. Army, 1935, p. 580).
2. Architect: U.S. Army Corps of Engineers
3. Original and Subsequent Owners: U.S. Army Corps of Engineers
4. Builder, Contractor: E. H. Latham Company
5. Original Plans: Proposal No. 34-108. Standard and Government Form of Invitation for Bids (Construction Contract), September 7, 1933, War Department, U.S. Engineers Office, Jacksonville.
6. Alterations and Additions: Two machinery houses constructed circa 1936 (Lake Okeechobee Project, Hurricane Gate Operators Houses, Proposal No. 436-36-130) by Contractor Paul H. Smith ("Copies of Specifications and Completed Contracts", Principal Engineer J. R. Peyton, U.S. Corps of Engineers). The original gate structure was mechanically operated with a manual capstan. In 1956, the manual capstan was replaced with an electrically operated Limitorque. The handwheel on the electrical unit could still be used in emergencies, but was considered impractical because of the excessive number of turns required to open the gate fully. In 1961, an LP gas engine with a belt drive was added to serve in case of a commercial power failure. (Hurricane Gates No. 2, 3, 4, and 5. Periodic Inspection Report No. 1 (September 1966), Appendix III - Pre-Inspection Brochure (1971)).

B. Historical Context: Hurricane Gate Structure 4 is one of five such structures authorized for construction in Lake Okeechobee by the River and Harbor Act of July 3, 1930, in accordance with Senate Document 115, 71st Congress, 2nd Session, as part of a levee and navigation channel project. This authorization represented the culmination of a series of natural and political events in the area.

Concern with water management in Central and Southern Florida has persisted since the 1840's. Drainage of wetlands allowed land reclamation and resultant land sales and agricultural development. Prior to 1926, the Everglades Drainage District took responsibility for regulating Lake Okeechobee. By the 1920's, canals to the lake had been constructed to allow navigation, including the North New River Canal now regulated by HGS 4.

By 1927, the Everglades Drainage District began experiencing serious financial problems, and by July all construction work halted. This financial crisis was bracketed by two natural disasters. Earlier in 1926, a serious hurricane resulted in property damage and the loss of 400 lives near Moore Haven. Later, in 1928, another more serious storm resulted in

flooding up to 8 feet and 2,000 deaths by drowning. Relief from the Red Cross totaled over \$2 million. These problems created the need for a new local agency to control water management in Central and Southern Florida and inspired the involvement of the Federal government in the process as well.

In response to these developments, the Florida Legislature created the Lake Okeechobee Flood Control District (Chapter 13711, Laws of Florida, Acts of 1929) to protect life and property from flooding in the areas around Lake Okeechobee and the Caloosahatchee River. As part of an effort to encourage federal involvement in water management, this newly created District hired George B. Hills, Hills Consulting Engineer of Jacksonville, Florida to prepare a history of the area and a proposal for future flood control efforts (Senate Document No. 225, 71st Congress, 3rd Session, April 30, 1930).

An act proposing Federal adoption of the Lake Okeechobee project was introduced in Congress in December 1929 and referred to the House Flood Control Committee. Despite the national attention given the 1926 and 1928 hurricanes, the U.S. Government was not interested in flood control projects at this time (with the exception of the Mississippi Valley). Consequently, the act was transferred to the Rivers and Harbors Committee for consideration as a navigation project where it was successfully translated into the River and Harbor Act of 1930, signed by President Herbert Hoover.

The project was adopted essentially as defined by the "Caloosahatchee River-Lake Okeechobee Drainage Areas, Florida" report prepared by the War Department (Senate Document 115, 71st Congress, 2nd Session, March 15, 1930). This report recommended the following:

That the United States improve the Caloosahatchee River and Canal from Lake Okeechobee to the Gulf of Mexico by straightening and by dredging a channel which will provide a discharge outlet capacity of 2,500 cubic feet per second from Lake Okeechobee and a navigation channel at least 6 feet deep and 80 feet wide, including the necessary control works, at an estimated cost of \$1,557,000; improve Taylor's Creek by providing a channel 6 feet deep and 60 feet wide from Okeechobee City into Lake Okeechobee at an estimated cost of \$58,000; provide a levee and a navigation channel 6 feet deep and 80 feet wide following in general the south shore of the lake at an estimated cost of \$6,172,000; improve the St. Lucie River to provide a channel 6 feet deep and 80 feet wide at an estimated cost of \$25,000; provide for the protection of the St. Lucie Canal from erosion and silting at an estimated cost of \$175,000; the levees to be subject to modifications of location and design at the discretion of the Chief of Engineers; provided that the State of Florida, or other local interests contribute \$1,175,000 toward the cost of the above improvements, furnish evidence satisfactory to the Secretary of War that they will construct the north shore levee to a design to be approved by the Chief of Engineers, estimated to cost \$1,040,000, provide all lands needed for levees,

channels, and the disposal of spoil, agree to maintain all work and channels within the limits of the Everglades drainage district and to charge no tolls on any of these navigable waterways and agree that whenever authorized by Congress the United States shall have the right to modify or improve any of these waterways and their appurtenant structures. It is further recommended that in adopting the project Congress expressly provide that the St. Lucie Canal, the Caloosahatchee Canal, and the other channels forming the proposed cross-State waterway, shall be navigable waters of the United States and subject to the Federal laws for the protection of such waterways. The total estimated cost of the above project to the United States will be \$6,812,000 for new work, with \$15,000 annually for maintenance in the Caloosahatchee River west of the western limit of the Everglades drainage district, and in the St. Lucie River east of the eastern limit of the Everglades drainage district (pp. 38-39).

Local interests, i.e. the Okeechobee Flood Control District, were to provide \$2,215,000 and all necessary rights-of-way. A subsequent amendment in 1935 reduced the local contribution to \$500,000 and rescinded the District's responsibility for maintenance after the project was completed.

Hurricane Gate Structures 2, 3, 4, 5, and 6 were constructed for a total cost of over \$1.5 million (reported total cost of \$1,612,449.60 in Report of Chief of Engineers, U.S. Army, 1948, p. 880; reported total cost of \$1,555,665.42 in A Report to the Board of Commissioners of Okeechobee Flood Control District, 1943, p. 18). HGS 4 is reported to have been the most expensive to construct (reported cost of \$350,025.30 in Report of Chief of Engineers, U.S. Army, 1948, p. 880; reported cost of \$344,446.35 in A Report to the Board of Commissioners of Okeechobee Flood Control District, 1943, p. 18). It was completed on February 26, 1935.

Construction of HGS 4 was conducted in accordance with the National Industrial Recovery Act of 1933. Workers were allowed to work a maximum of 30 hours per week for a minimum wage of \$1.00/hr. for skilled labor and \$.40/hr. for unskilled labor. No convicts could be hired, and preference was given to ex-servicemen with families and men from the "southern region".

PART 11: ARCHITECTURAL INFORMATION

A. General Statement:

1. Architectural Character: Functional.

2. Purpose: Each year in advance of the hurricane season, the lake level is drawn down to elevation 15.5, in order to provide additional flood storage capacity. The primary function of Hurricane Gate 4 is to close the drainage canal opening which passes flow through the Lake Okeechobee levee system to Hillsboro and North New River Canals during hurricane periods. Hurricane Gate 4 provides control for regulatory discharges and also passes sufficient discharges during normal and low flow periods to maintain stages in the downstream canals and satisfy mitigation demands.

3. Description of Structure: Hurricane Gate Structure 4 consists of a pair of steel sector gates, installed in a concrete structure located at the intersection of the levee and canal centerlines. The structure is symmetrical about the centerline axis of the approach canal. The structure is oriented such that the approach canal at the structure site is at right angles with the levee. The masonry portion of the structure serves a dual purpose supporting the sector gate and retaining the levee embankment.

B. Description of Exterior

1. Over-all dimensions: Hurricane Gate Structure No. 4 is approximately 112-feet-long with a chamber width of 50 feet. Gravity wingwalls about 101 feet long extend upstream on the lakeside of the structure.

2. Foundations: The structure is founded on a rock, 1 to 3-feet-thick. This layer is underlain by sand and shell and another rock layer about 10-feet beneath the base.

3. Walls and Floor: The structure is constructed with concrete walls and a concrete floor. The walls of the gate chamber are gravity sections with stepped backslopes. Expansion joints divide each chamber into four monoliths. The walls are separated from the chamber floor by expansion joints.

4. Structural System, Framing (Gates): The sector gates are constructed of riveted structural steel. They are constructed of structural steel framing with a skin plate. The gates are 32-feet-high with a central angle of 60 degrees for each gate. The water load on the skin plate is transmitted to horizontal girders. The girder loads are transmitted to the hinges and pintle. Needle beam recesses are provided each side of the gates to permit dewatering the bay.

5. Openings:

(a) Doorways and doors:

The door frames are made of 3/8-inch steel plates with the doors being made of 1/4-inch steel plates reinforced on the back with 1-inch channels.

(b) Windows:

Four 1' -2 5/8" x 2' -9 3/8" glazed windows were provided at each operator's house.

(c) Hardware:

Each window was supplied with a malleable iron cam handle and a stay bar. Hinges with bronze pins were provided for all windows and doors. Locking bolts and padlocks were provided for all doors.

6. Operator's Houses:

Two reinforced concrete operator's houses were provided at Hurricane Gate No. 4. - one over each machinery pit.

C. Description of Interior

Mechanical Equipment:

The history of HGS-4 operating machinery is as follows:

(a) 1935 - Manual: The original structure was provided with a manual capstan for gate operation.

(b) 1956 - Electric: The structure was modified to replace the manual capstan with an electrically operated Limitorque unit. The gate could still be operated manually via a handwheel on the Limitorque; however, the number of turns required on the handwheel to effect full gate travel was so great that handwheel operation as a method of standby in case of motor failure was impractical.

(c) 1961 - Gas Engine standby: A gas engine with belt drive was added as an emergency standby method of gate operation in case of commercial power failure.

D. Site:

General settings and orientation: Hurricane Gate No. 4 is located in Herbert Hoover Dike at the confluence of the Hillsboro and North New River canals on the south side of Lake Okeechobee 3.5 miles west of Belle Glade, Florida. Access to the structure is via State Road 715 from Belle Glade for a distance of about 3 miles to the levee, and thence in a south-westerly direction along the top of the levee for a distance of about 2800 feet.

PART III: Sources of Information

A. Architectural Drawings: Microfilms of original, September 1933

B. Interviews:

Noble Enge, U.S. Army Corps of Engineers, Jacksonville District, Flood Control.

C. Bibliography:

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U.S. House, Comprehensive Plan for the Central and Southern Florida Control Project, House Document No. 643, 80th Congress, Second Session, 1948.

U.S. Senate, Caloosahatchee River and Lake Okeechobee Drainage Areas, Florida. Letter from the Chief of Engineers, United States Army to the Chairman of the Committee on Commerce, U.S. Senate Presented by Mr. Fletcher, January 6 (March 18), 1930, 71st Congress, Second Session, Senate Document No. 115, 1930.

_____, Caloosahatchee River and Lake Okeechobee Drainage Areas, Florida. A Report to the U.S. District Engineer, Jacksonville Florida Submitted by Okeechobee Flood Control District of Florida, presented by Mr. Fletcher, December 3, 1930, 71st Congress, Third Session, Senate Document No. 225, 1930.

War Department, "Proposal No. 34-1D8. Standard Government Form of Invitation for Bids (Construction Contract)", U.S. Engineers Office, Jacksonville, September 7, 1933. (Available, U.S. Army Corps of Engineers, Jacksonville District).

Will, Lawrence E., Okeechobee Hurricane and the Hoover Dike: An Eyewitness Account of the Nation's Third Largest Calamity, St. Petersburg, Florida: Great Outdoors Publishing Company, 1961.

_____, A Cracker History of Okeechobee, St. Petersburg, Florida: Great Outdoors Publishing Company, 1964.

D. Supplemental Material:

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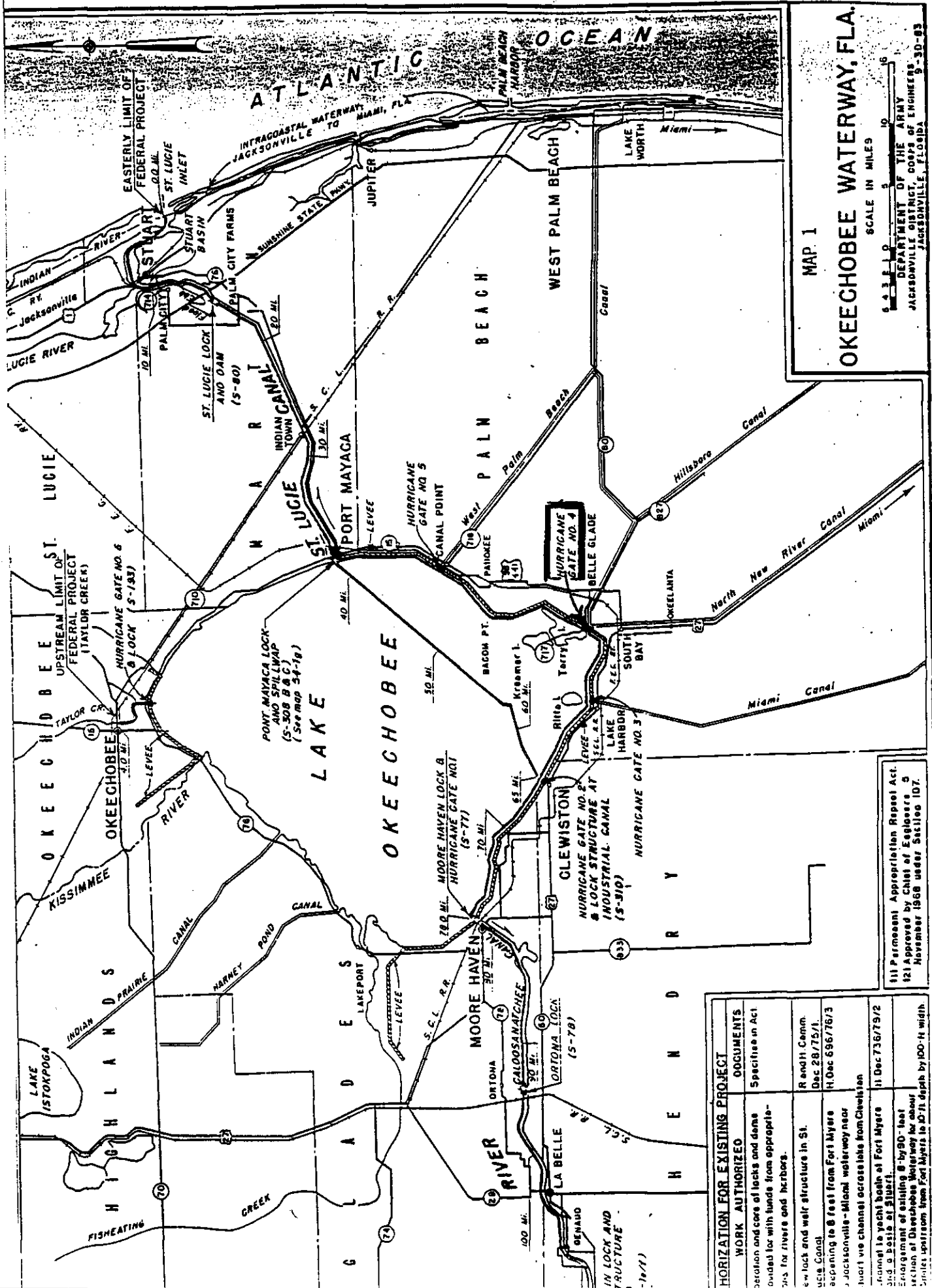
PART IV: Project Information

This project involves replacing Hurricane Gate Structure 4 with a - spillway containing three 20-foot bays (S-351). S-351 will be located immediately downstream (landside) of the extant hurricane gate. The spillway will utilize a major portion of HGS 4 but will necessitate removal of its east wall and the sector gates. This work is necessary because of changes in the Lake Okeechobee regulation schedule which entailed raising lake levels to 15.5 to 17.5 feet, m.s.l. in May 1978. Prior to this time, the lake was regulated seasonally with schedules ranging from 12.5 to 16.00 feet, m.s.l. During January 1980, the necessary irrigation releases from HGS 4 caused erosion of the downstream canal banks and bottom, and of the riprapped bottom of the structure chamber itself. This experience demonstrated the inadequacy of the HGS to operate satisfactorily under the changed conditions. The new spillway will accommodate the high rate of flow and will have the capability to discharge the full authorized regulatory and irrigation releases to Hillsboro and North New River Canals with the new lake regulation schedule.

Conversion of HGS 4 to a spillway S-351 is associated with the Comprehensive Plan for the Central and Southern Florida Control Project, originally presented in House Document No. 643, 80th Congress, Second

Session, and authorized by the Flood Control Act aproved 30 June 1948 (PL-858, 80th Congress, Second Session). This plan provided for raising the Herbert Hoover Dike (levee system) around lake Okeechobee to conserve the water for use during dry periods and to provide protection during severe hurricanes. Modification of Hurricane Gate Structure 4 is required to satisfy those needs without causing erosion and damage.

S-351 was designed by the U.S. Army Corps of Engineers and will be operated and maintained by the Corps. It will be constructed by a contractor. The South Florida Water Management District (SFWMD) is authorized to represent local interest and is responsible for 15% of the estimated construction cost. The SFWMD will also provide all lands, easements, and rights-of-way (to be furnished in the name of and held by the U.S. Government).



HORIZON FOR EXISTING PROJECT	
WORK AUTHORIZED	DOCUMENTS
Location and core of locks and dams provided for with funds from appropriate sources for rivers and harbors.	Specified in Act
Low lock and wall structure in St. Lucie Canal	R and H Comm. Dec. 28/75/1 H. Dec. 696/76/3
Enlargement of existing 8'-by-90'- foot section of Okeechobee Waterway for about 100 ft. upstream from Fort Myers to 10 ft. depth by 100-ft. width.	H. Dec. 736/75/2

111 Permanent Appropriation Repeal Act.
112 Approved by Chief of Engineers 5
November 1968 under Section 107.